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Instrument Business Outlook

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International Phenome Center Network to Advance Metabolic Phenoyping

Defined as the small molecules that make up biological systems and are present in biofluids or tissues, metabolites can be indicative of not only the internal factors related to disease but also the contribution of external factors, such as environment and lifestyle. Metabolomics, the study of metabolites and their interactions, can provide insight into an individual's current health status and disease predisposition. Other applications include the use of metabolites as biomarkers, for disease treatment and monitoring, for patient stratification in clinical trials and for drug development.

Metabolic phenotyping is the comprehensive, simultaneous profiling of the metabolites in a sample. Utilizing LC/MS and NMR, researchers can identify and quantify the hundreds to thousands of metabolites found in a single sample. The techniques are complementary as LC/MS provides high sensitivity, while NMR is nondestructive and highly reproducible.

Launched earlier this month, the International Phenome Center Network (IPCN) is a new international effort aimed at advancing the development and use of metabolic phenotyping for phenomics, the study of the interaction of genes and the environment. The IPCN has announced seven centers so far (see table below). Each center will be self-funded, but the IPCN will be overseen by a steering committee consisting of a representative of each member.

Announced IPCN Partners	Location
MRC-NIHR National Phenome Centre	Imperial College, London, UK
Imperial International Phenome Training Center	Imperial College, London, UK
Clinical Phenotyping Centre	Imperial College, London, UK
Phenome Centre Birmingham	Uniiversity of Birmingham, UK
Birmingham Metabolomics Centre	University of Birmingham, UK
Singapore Phenome Centre	Nanyang Technological University, Singapore
Australian Metabolic Phenotyping Centre	Murdoch University, Murdoch, Australia

Among the founding members are instrument suppliers Bruker and Waters, which will provide technical support and development for NMR and LC/MS, respectively. Specifically, Waters will work to develop technology and methodology, as well as provide training for IPCN researchers, which will take place at an existing facility at Imperial College currently staffed by Waters employees.

Bruker will provide technical support and development for NMR for the IPCN. “The opportunity for NMR is to contribute to the big quest for precision health and, there in, metabolic phenotyping is a key element in prediction, prevention and curing,” commented Iris Mangelschots, PhD, president of Bruker’s AIC (Applied, Industrial and Clinical) Division at Bruker.

The IPCN is coordinated by the UK’s Medical Research Council (MRC) and National Institutes of Health Research (NIHR)– sponsored National Phenome Centre, one of the world’s largest metabolomics centers.

Founded in 2013, the National Phenome Centre, in which Bruker, Waters and Imperial College London are partners, is focused on both targeted and nontargeted metabolomics for biomarker and population-based studies, including the development of methods and standards. It has received a funding commitment of £10 million ($15 million = £0.65 = $1) over five years from the UK government.

The IPCN builds upon the work of the National Phenome Centre. As Rohit Khanna, PhD, senior vice president of Waters’ Applied Technology Group, told ***IBO***, Waters’ work with the Centre has led to advancement in LC/MS hardware and software for metabolic phenotyping. A focus of the partnership has also been the development of LC/MS standards and methods for metabolic phenotyping. “A lot of work has been done [at the National Phenome Centre] to standardize methodologies to be able to do large-scale population analysis: to run that number of samples through the LC/MS systems and to correlate the data. To do this consistently was critical,” noted Dr. Khanna. “I think the work that has been done over the first few years has allowed us to put that standardization in place.” With the IPCN, these standards, methods and technology developments will now be applied to larger sample sets.

Bruker’s work with the National Phenome Centre also involved the development of methods and standards for NMR for metabolic phenotyping. Describing the benefits of standardized and harmonized methods for the IPCN’s multiple centers, Dr. Mangelschots told ***IBO***, “Because we are working within a controlled NMR measuring set, which is described in our SOP, [the centers] can easily exchange data; exchange data for doing similar studies, but on a much larger amount of samples, or even changing disciplines,” she said.

In addition, Bruker's partnership with the Centre has led to technical developments, including technology focused on sample preparation for NMR. Manfred Spraul, PhD, CTO of Bruker BioSpin's AIC Division, described the development of an automated sample preparation system to keep tissues cool prior to analysis "[So when] we want to run something like 500 to 600 samples in one go on a sample changer, we need cooling."

In addition to the application of standards and methods to higher volumes, the IPCN's global presence is also a key development. As Dr. Mangelschots explained, an international focus is essential to advancing the field. "There are IPCN members at different physical locations from a geographical perspective, so they have access to biosamples from different regions," she noted.

In particular, the IPCN will benefit from uniquely large data sets, which allow for improved correlation of metabolites with disease states, human health and environmental factors. "With rare exception, there are only a couple of centers globally that are working at this level of volume," explained Dr. Khanna. "Before the IPCN, few labs existed with the capacity and size of investment in metabolomics to run such large-scale samples. To the volume that we are talking about, which is tens of thousands of samples, you need a large laboratory with large investment and a large number of systems."

Dr. Khanna told ***IBO*** that he expects the IPCN to expand to 10 centers over the next couple of years. Areas of research will be varied, depending on each individual center's focus. However, certain diseases will be prioritized across all centers. "It hasn't yet been decided by the network which will be the top three or four initial areas, but I can assume, from my conversation with them, diabetes will probably come up high on the list, autism is one that seems to be high on the list, [and] probably some of the cancers."

The selection of which centers will participate was designed to represent geographical and disease diversity, according to Dr. Mangelschots. "All the members of the IPCN have strengths in certain clinical questions. This is how they are selected; either they have complementary strengths or have reach within important geographical areas from the biosample perspective."

For NMR, the capabilities will extend to retrospective testing of samples for other diseases. "I think it is a unique capability of NMR that, once you have a spectrum measured, you can look to cardiovascular issues, and, at the same time, you can look with the same spectrum, you can look into diabetes, hypertension and cancer, for example," noted Dr. Spraul. "You can stress test new test assays on much bigger data samples, which you might have measured several years ago," explained Dr. Mangelschots.

For Bruker, the IPCN also advances the clinical promise of metabolic phenotyping using NMR. "We would like our standards to move into a CE- or a 13485- or even an FDA-based platform. That platform would be our system and platform-enabling tools within these SOPs, so that any partner within the IPCN and beyond who is a developing a test can then go into LDT with their assay or even inspire an FDA approval," stated Dr. Mangelschots.

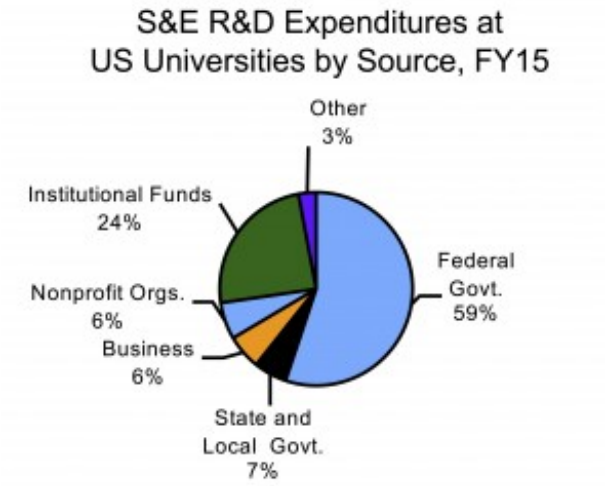
For LC/MS, Dr. Khanna explained that the IPCN is representative of the technology's importance to personalized medicine and study of the human phenotype. "Of all the different omics that are going to be necessary, LC/MS is critical in all of those omics with the exception of genomics." He told ***IBO***, "When someone says personalized medicine, when someone says microbiome initiative, it is within this bigger umbrella of metabolic phenotyping. It all fits together. You have to answer these fundamental questions," he said. "I think the time is really good right now for this whole industry around the expansion of medical research into phenotyping—into all the different omics areas."

Federal University R&D Expenditures Continues Steady Decline

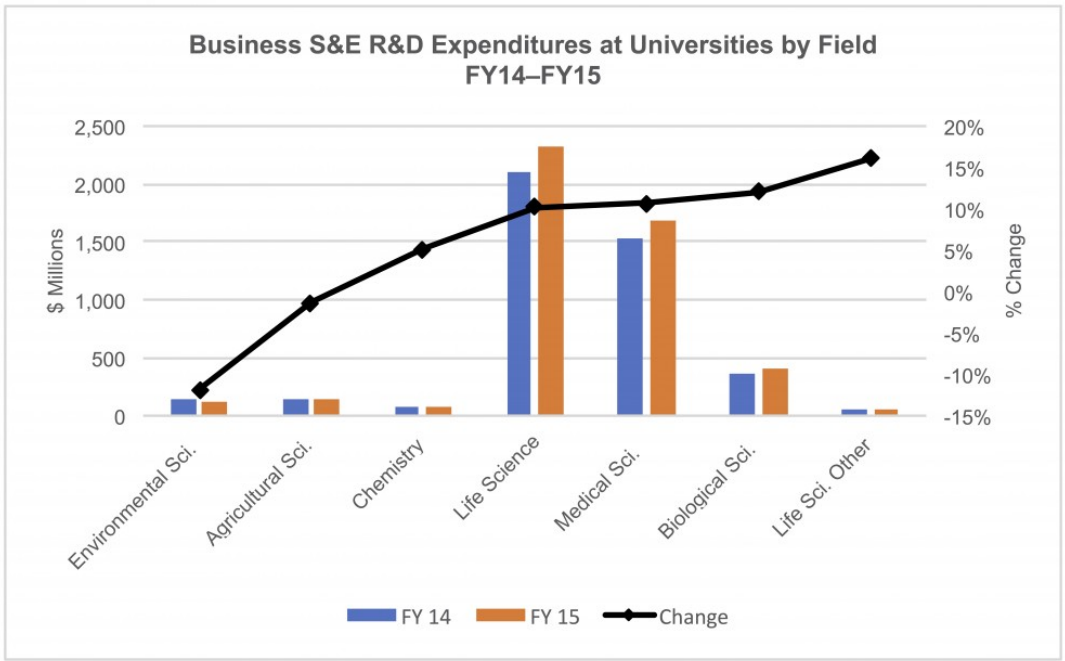
Based on the NSF's "Higher Research and Education Development Survey" (HERD), in FY15, federal funding for science and engineering (S&E) R&D decreased for the fourth straight year. The report surveyed 906 universities and colleges that grant at least a bachelor's degree and spent a minimum of $150,000 in 2015 on S&E R&D. Although universities' R&D expenditures in 2015 increased by 2.2% to $68.8 billion, government funding has been on a multiyear decline. Adjusted for inflation, federal funding for academic R&D decreased 1.7% in 2015; in current dollars, government funding for R&D decreased 0.2% to $37.9 billion. In the past five years, federal R&D funding as

a share of academic funding has dropped approximately 7%, from 62.5% in 2011 to 55.2% of total university R&D expenditures in 2015.

By department, the Department of Defense, NASA and the Department of Agriculture increased academic R&D outlay in fiscal 2015, while all other federal agencies decreased them, like the Department of Human Health and Services, which declined 1.2% to $20 billion in 2015. Funding from state and local governments also decreased, dropping 1.2% to $3.8 billion.

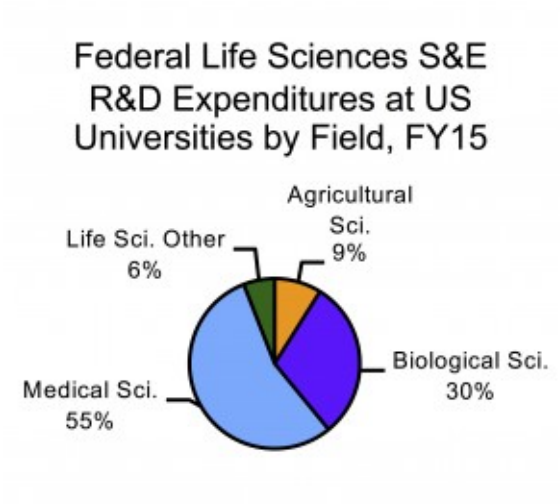


Non-government funding sources all experienced an increase in expenditures, with institutional funds from universities increasing 5.9% to $16.7 billion in 2015, a 33% increase from 2011. Business R&D investments increased 7.5% in 2015 to reach $4 billion. As illustrated in the graph below, business R&D funding grew in almost every field, with the largest growth in general life sciences, for which it grew 15.8% in 2015 to $2.3 billion. Business R&D expenditures on biological sciences jumped 12.0% to $408.6 million, while medical sciences and chemistry increased 10.6% and 5.0% to $1.6 billion and $81.7 million, respectively. Spending for environmental sciences fell 12.1% to $127.3 million and agricultural sciences expenditures dropped 1.6% to $147.7 million.



Nonprofit R&D expenditures for universities grew 6.9% in FY15 to $4.2 billion. Other sources of R&D funding, such as capital from research donors, foreign governments or sponsors, increased 6.4% to $2 billion. Over 75% of funding from outside sources were used as grants, reimbursements or similar types of arrangements. Since 2011, this type of funding has decreased 10.1%, totaling 76.7% of total university R&D expenses in 2015.

University R&D spending for the life sciences field, which includes agricultural sciences, biological sciences and medical sciences, grew 2.3% to $38.8 billion. The majority, or 64%, of R&D expenditures by universities was split between medical sciences, biological sciences and engineering, which received $21.3 billion, $11.7 billion and $11.1 billion, respectively, in 2015. R&D funding for the medical sciences field grew 3.1% in current dollars to $21.3 billion, while agricultural sciences grew 2.2% to $3.5 billion. In the physical sciences, R&D expenditures for chemistry grew 2.0% to $1.8 billion.



The NSF survey also analyzed university R&D disbursements for equipment. The NSF's definition for research equipment as included in the HERD survey is "payments for movable equipment exceeding the institution's capitalization threshold, including ancillary costs such as delivery and setup." As per the definition, general equipment purchases are excluded, as the equipment purchased by the university must be part of a particular research project.

All total R&D expenditures by universities for research equipment from federal and nonfederal sources increased in 2015. Total life sciences R&D expenditures by universities grew 11.3%, which includes a 12.6% increase from public sources and an 8.5% increase from private sources. Total R&D expenditures by universities grew 8.3%, with expenditures from public and private sources rising 12.5% and 2.9%, respectively. Nonfederal total expenditures for R&D equipment also rose 13.0% in 2015, with contributions from public sources increasing 12.6% and private sources increasing contributions by 14.2%.

University S&E R&D Expenditures for R&D Equipment by Field & Source, FY15

Field	Total ($M)	Federal ($M)	Nonfederal ($M)
Life Sci. Total	817.9	298.2	519.7
Agricultural Sci.	90.0	23.0	66.9
Biological Sci.	333.5	135.2	198.3
Medical Sci.	322.5	123.9	198.6
Life Sci. Other	71.9	16.0	55.8

Total university R&D expenditures for agricultural sciences grew 7.1%, while expenditures for biological and medical sciences increased 7.7% and 8.8%, respectively. Expenditures for all other life sciences rose the most, increasing 59.8%.

By institution, John Hopkins University reported the greatest R&D spending in fiscal 2015 at $2.3 billion, a 2.9% increase, followed by the University of Michigan, Ann Arbor with a 1.5% increase to $1.4 billion, and the University of Washington, Seattle, which rose 0.4% to $1.2 billion. The University of Texas, Austin rounded out the top 30 list with an 11.3% increase in R&D funding to $651 million, knocking Vanderbilt University to 31st place with $648 million. The top 30 institutions represent 41.3% of total academic R&D expenditures.

Roche Terminates Agreement with Pacific Biosciences

Menlo Park, CA 12/15/16; Pleasanton, CA 12/15/16—Roche has announced that it plans to end its agreement with Pacific Biosciences for development and supply of an NGS system for the clinical market. “As a result of this decision, we will have greater focus on our internal development efforts and drive our long-term strategy, which is to be a leader in clinical diagnostic sequencing,” commented Neil Gunn, head of Roche Sequencing Solutions. Consequently, Pacific Biosciences will be free to sell the system into any end-market. “The clinical research and sequencing market and regulatory environment have evolved during the three years since we entered into this agreement with Roche. While we are disappointed with Roche’s decision to terminate the agreement, we are already familiar with this market and Roche’s decision does not significantly change our near-term plans for expanding our business to address this market,” stated Pacific Biosciences CEO Dr. Michael W. Hunkapiller. “The long-term goal of this agreement was for Roche to pursue the *in vitro* diagnostic market with regulated, assay-specific tests based on the Sequel platform and, to that end, Roche was focused on developing certain targeted assays and additional software features on the Sequel System.” Pacific Biosciences stated that it was prepared to pursue the segment of the clinical research market that does not require assay-specific kits. Pacific Biosciences expects 2017 sales to grow 40%–60%.

The Roche sequencing system’s release had been scheduled for early to mid-2017, according to Pacific Biosciences. Describing the issues that Roche may have encountered, Dr. Hunkapiller stated on a conference call, “What they’ve explained to us, in a sense, is that it is more of a timeline of when they wanted to get their system out on some specific assays that was the issue.” In general, he noted that “based on the interest level we currently see from customers in this space, we believe the majority of the clinical sequencing market does not want or need such assay-specific kits to be supplied along with the sequencer.” The company intends to sell the Sequel system into the LDT market, noting that many of these labs are also its research customers. “As the sequencing market for diagnostics or clinical testing has developed, it is less daunting, even for a company our size, to go at it aggressively than it looked like it was going to be three years ago,” said Dr. Hunkapiller. The company will also consider partnerships with test developers and regional distributors. Pacific Biosciences emphasized that its system had met all the technical requirements of the Roche agreement.

DuPont Sells PCR Business

Camarillo, CA and Wilmington, DE 12/14/16—Microbiology and life science firm Hygiena has agreed to acquire DuPont Nutrition & Health’s food safety diagnostics business for an undisclosed amount. Hygiena will acquire systems and test kits; sales, R&D and manufacturing organization; and production capacity. The systems include DuPont’s BAX PCR products for food safety testing and its RiboPrinter ribotyping system for microbial monitoring. “The combined company’s microbiology products will cover the full manufacturing process, from in-process environmental tests to finished product tests,” stated Hygiena CEO Steve Nason. “In addition, the combination increases our customer service presence in the United States and internationally, which will allow us to further enhance our research and development efforts and support to our combined customer base.” DuPont stated that it was selling the business in order to focus on its specialty food ingredients portfolio. The deal is expected to close in

the first quarter of 2017.

The BAX system enables both real-time and end-point PCR, and is based on technology licensed from Roche, Thermo Fisher Scientific (Applied Biosystems) and QIAGEN (formerly DxS). According to delawareonline, DuPont's food safety diagnostics business has about 70 employees. The acquisition adds PCR technology to Hygiena's food safety product lines, which also includs ATP systems and tests, as well as allergen and surface-residue tests.

Teledyne Enters Dissolution Testing Market

Thousand Oaks, CA 12/6/16; Chatsworth, CA 12/7/16—Teledyne Technologies, a provider of instrumentation and systems, has purchased Hanson Research, a developer and supplier of dissolution testing systems and other products, for an undisclosed amount. "Hanson Research's line of dissolution and diffusion instruments complement Teledyne's portfolio of laboratory instrumentation businesses, including Teledyne CETAC's automation systems, Teledyne Tekmar's sample preparation instruments, and Teledyne Isco's chromatography products," stated Teledyne Chairman, President and CEO Robert Mehrabian. "Furthermore, Hanson Research will strengthen Teledyne's relationships with global life sciences and pharmaceutical companies." Hanson Research stated that the acquisition will allow it to expand resources and accelerate R&D. Hanson Research will retain its name and California-based operations. The company will be renamed Teledyne Hanson Research.

*Keith Hamman, president of Teledyne Hanson Research and a long-term Hanson Research employee, will now run the company. He told **IBO** that the purchase gives Hanson Research "more resources to accelerate our extensive R&D pipeline." Hanson Research has 46 employees.*

Cole Parmer Acquires Bibby Scientific

Stone, UK 12/13/16; Stone, UK 11/30/16—According to Bibby Scientific's website, the lab equipment supplier has been acquired by Cole Parmer, a manufacturer and distributor of lab and industrial fluid handling products, instrumentation, equipment and supplies. Bibby Scientific announced on its website that it will change its name to Cole Parmer in January 2017. Nova Capital Management, Bibby Scientific's former owner (see ***IBO*** 10/31/07), stated on its website that it has divested the business. Bibby Scientific also announced on its website that Cole Parmer has acquired Argos Technologies, a US-based supplier of lab equipment.

Neither Cole Parmer's owner, private equity firm GTCR, nor Nova Capital could be reached for comment. The purchases are a further investment by Cole Parmer's new owner into the lab products market. The purchase of Bibby Scientific adds to Cole Parmer's international presence.

Anton Paar Acquires Raman Technology

Graz, Austria 12/1/16—Instrument provider Anton Paar, through its Anton Paar OptoTec subsidiary, has acquired the benchtop Raman spectroscopy instrument products of BaySpec for an undisclosed amount. Anton Paar has also acquired a license to handheld Raman technology from SciAps. Financial details were not disclosed. "From both a business and a technological point of view, this purchase of products and technology represents a future-oriented step for Anton Paar in Seelze, Germany. We have now entered the field of molecular spectroscopy," commented Nils Bertram, general manager of Anton Paar OptoTec. The company stated that the purchases expand its portfolio of technologies for its pharmaceutical industry and chemical industry customers.

*Asked about the company's entry into the Raman spectroscopy market, Mr. Bertram told **IBO**, "Anton Paar is renowned for high precision instruments measuring physical properties, primarily of liquids. Changes in these properties, e.g., density, refractive index, viscosity or elasticity, can be detected quickly. A chemical fingerprint*

delivered by Raman can help to identify the cause of any observations regarding physical properties. This makes Raman an ideal combination for many existing products." He added that Anton Paar will target both research and QA applications.

Biolin Scientific Sold

Stockholm, Sweden 12/7/16; Stockholm, Sweden—AddLife, a provider of life science products for the Nordic region, has agreed to acquire Biolin Scientific from investment firm Ratos. Financial details were not released. Biolin Scientific provides analytical instruments for nanoscale material analysis and has 61 employees. For the 12-month period ending September 2016, Biolin revenues totaled SEK 100 million ($12 million = SEK 8.43 = $1), and it generated an operating EBITA of SEK 6 million ($711,000). Biolin will retain its Drug Discovery subsidiary, consisting of Sophion, which will be run as an independent company.

Ratos stated that it does not expect a significant financial gain from the divestment. Biolin Scientific products include tensiometers, Quartz Crystal Microbalance–based systems, and thin film fabrication and characterization systems. For the nine months ending September 30, Biolin Scientific sales, including Sophion, declined 13.9% to SEK 142 million ($16.9 million = SEK 8.40 = $1).

Merck KGaA to Distribute Kapa Biosystems' qPCR and Endpoint PCR Products

Pleasanton, CA 12/1/16; Billerica, MA 12/1/16—Merck KGaA will take over distribution of Roche's Kapa Biosystems qPCR and endpoint PCR products worldwide with the exception of the US, Japan and Brazil. The agreement excludes Kapa's NGS products. "These enzymes represent a significant advantage over commercially available DNA polymerases and thus offer the potential for entirely new PCR applications," stated Udit Batra, member of the Merck Executive Board and CEO of its Life Science business. The transition is expected to be completed by January 1, 2017.

*The agreement is an expansion of Merck (previously Sigma-Aldrich) and Roche's 2015 agreement for distribution of Roche's Biochemical Reagents (see **IBO** 3/31/15). The agreement adds to Merck Life Sciences' PCR offerings and signals Roche's further retreat from distribution of non-NGS research products.*

Spectris Merges Malvern and PANalytical Businesses

London, UK 12/2/16—Instrumentation and control firm Spectris has announced the merger of its Malvern and PANalytical business, which are both part of its Materials Analysis segment. "Joining the two companies will enable us to leverage new resources to further grow our service offering and add even more value to our clients and customers," commented Eoghan O'Lionaird, Business Group director responsible for Materials Analysis. "This aligns closely with the Spectris strategy of a shift in emphasis towards the provision of complete solutions to our customers, allowing us to better deliver this to our Malvern and PANalytical customers." Paolo Carmassi has been named president of the merged operating company. Most recently, he served as operating partner at CSTS Healthcare. The respective presidents of PANalytical and Malvern, Peter van Velzen and Paul Walker, have retired.

As Mr. O'Lionaird told **IBO**, *the combined group of Malvern and PANalytical will be the largest firm within the Materials Analysis segment of Spectris, enhancing potential for business growth. "We believe that there are strong benefits from a combination of the two companies that will deliver more possibilities for business growth than on a stand-alone basis," said Mr. O'Lionaird . "The combination of our two companies is a strong player in the materials*

characterization market that will be able to leverage the strengths of the individual companies in particular markets and processes to grow faster. By leveraging the very strong brands and the highly skilled employees of the two companies, we believe we will be able to deliver a more complete range of products, solutions and services to a broader set of markets and customers."

Asked why the companies decided on the merger at this point in time, Mr. O'Lionaird explained, "As end-markets have become more challenging, we believe that merging the two businesses will enable us to offer an improved value proposition to a shared customer and market base by complementing each others' product and applications strengths."

Lucigen to Distribute Illumina Subsidiary's Products

Middleton, WI 11/29/16—Life science supplier Lucigen has announced that it will exclusively manufacture and sell certain Epicentre Technologies products, starting January 1, 2017. Epicentre is an Illumina subsidiary. Lucigen will offer Epicentre products for transposomics, microarray analysis and transcriptomics. "We are excited to expand and enrich our product offering to serve scientists worldwide with unique tools that will deliver innovative and meaningful breakthroughs in life sciences," commented Lucigen CEO Ralph Kauten.

Illumina acquired Epicentre Biotechnologies in 2011 (see **IBO** *1/15/11), primarily for its Nextera NGS library preparation technology. As such, Epicentre's other products may not have been considered core to Illumina's business, especially as it makes operational changes under a new CEO.*

Third Quarter Financial Results

HIV Business Slows BD Biosciences Growth

Fiscal fourth quarter revenue for Becton, Dickinson's BD Biosciences unit improved 3.6%, or 4.0% excluding currency, to $296 million to make up 9% of company revenues. Growth was driven by demand for high parameter research systems, including the FACSymphony, FACSCelesta and newly launched FACSMelody. Regional sales in the US grew 8.0% to account for 38% of Biosciences revenues. However, International sales, which advanced 1.5% excluding currency, were hampered by continued challenges in the clinical HIV business in Africa. Excluding the HIV business, Biosciences sales would have climbed roughly 6% organically.

For the fiscal year 2016 ending September 30, BD Biosciences sales declined 1.2% to $1,119 million. However, excluding currency, segment sales advanced 1.5% and nearly 3% without the HIV business, driven by the new product introductions mentioned above. US sales expanded 7.9%, while International revenue slipped 2.1% excluding currency to account for 39% and 61% of segment revenue, respectively.

New Products Incite Bio-Techne Sales

For the fiscal first quarter ending September 30, revenue for Bio-Techne's Biotechnology segment climbed 6% organically. All product lines performed well, especially antibodies, for which sales grew double digits. In addition, combined sales and royalty revenues for multiplex assays also climbed double digits. The company highlighted two new assay products from the acquired Advanced Cell Diagnostics (ACD) business (see ***IBO*** 7/15/16), which contributed to the more than 50% sales growth for ACD on a standalone basis. However, the acquisition negatively impacted adjusted operating margin for the Biotechnology segment, which contracted 300 basis points to 48.9%.

For the third consecutive quarter, sales for Bio-Techne's Protein Platforms segment advanced more than 20%. Most major regions and product lines grew double digits. Growth was particularly strong for the imaging capillary

electrophoresis system, Maurice. In addition, Simple Plex revenue soared nearly 150%, led by demand for the automated multi ELISA system, Ella. Demand for the Western Simple product line also remained strong. Following the acquisition of Zephyrus Biosciences in March (see ***IBO*** 3/31/16), the company launched its first automated single-cell western blot instrument, for which initial interest and sales surpassed company expectations. Adjusted operating profit for the segment was $0.2 million, compared to a loss of $1.2 million.

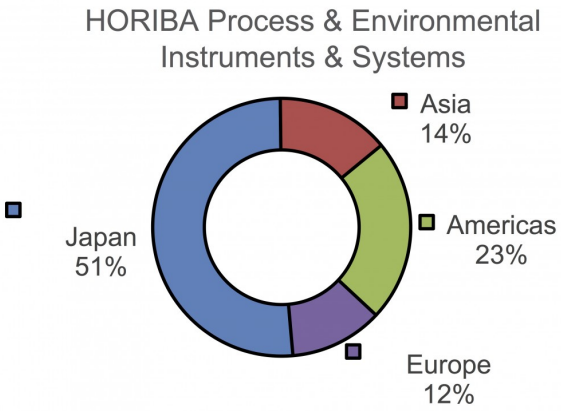
For the total company, which includes the non-OEM diagnostic revenue, both Europe and US sales grew in the high single digits, including mid-single and high single growth from academic and biopharmaceutical markets, respectively. Despite pressure on PrimeGene sales as a result of China's FDA regulatory changes, total sales in China grew nearly 20%. Other Asia regions, such as India and Korea, performed very well, while Japanese sales declined in the mid-single digits. Fiscal 2017 organic sales are projected to grow roughly 6% or slightly higher.

Bio-Techne Q1 FY17				
	Rev. (M)	% of Rev.	Rev. Growth	Org. Growth
Biotechnology	$86.8	66%	15%	6%
Diagnostics	$24.2	19%	19%	19%
Protein Platforms	$19.6	15%	20%	20%

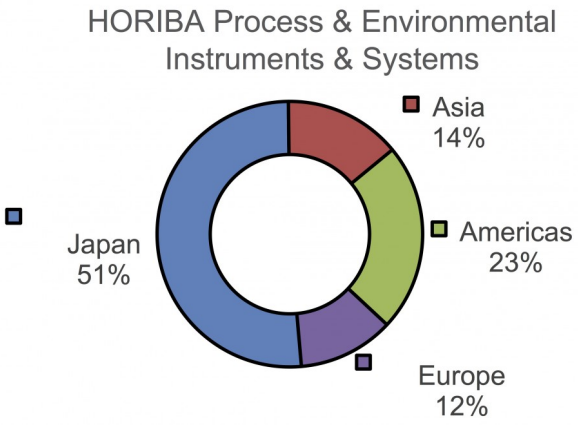
HORIBA Realizes Regional Strength

For the third quarter, HORIBA's Process and Environmental Instruments & Systems (P&E) sales climbed 8.8% to ¥4.01 billion ($39.2 million = ¥102.38 = $1) to account for 11% of revenues. Excluding currency, P&E sales grew roughly in the high teens, led by vigorous demand from petrochemical customers in the Americas. As such, currency-neutral sales in the Americas soared roughly 50%. In addition, regional sales in Japan grew roughly 24%. Conversely, sales in Asia declined in the low single digits excluding currency due to lower sales of stack-gas and water quality analyzers in China, South Korea and other Asian regions. European sales were also weak, contracting roughly in the high single digits excluding currency.

P&E operating margin expanded 50 basis points to 6.3%. The company maintained its 2016 P&E revenue outlook of ¥16.5 billion ($154.0 million = ¥107.00 = $1), but increased its operating income forecast by 15% to ¥1.5 billion ($14.0 million).



HORIBA's Scientific Instruments & Systems (SI) sales waned 5.6% to ¥5.77 billion ($56.3 million) to account for 16% of company revenues. However, this decline was prompted by currency translation, as sales improved roughly 7% in local currency. Sales growth in Asia was robust, climbing more than 30% on a currency-neutral basis. Following modest growth in the first half of the year, Japanese sales climbed 24%. Nevertheless, sales in the Americas and Europe, which declined in the high single digits each, were hampered by weak academic funding.



Segment operating profit faded from a modest gain to a loss of ¥177 million ($1.7 million) due to currency headwinds. SI's full-year revenue and operating income outlook was reduced 4% and 20% to ¥26.0 billion ($243.0 million) and ¥0.8 billion ($7.5 million), respectively.

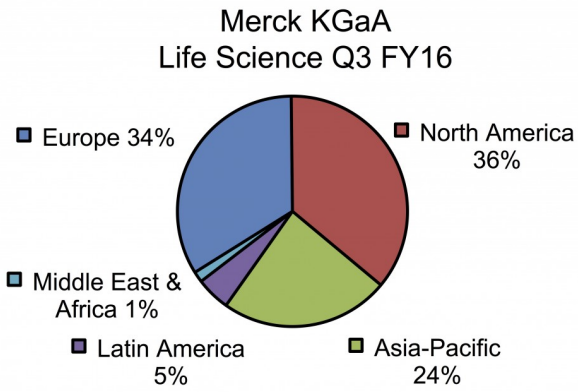
HORIBA Q3 FY16			
	Rev. (M)	Rev. Growth	% of Rev.
Process & Environmental Instruments & Systems	¥4,010	8.8%	11%
Scientific Instruments & Systems	¥5,767	-5.6%	16%

Merck KGaA Delivers Sturdy Process Sales

Third quarter sales for Merck KGaA's Life Science (LS) division climbed 83.1%, 5.7% organically, to €1.39 billion ($1.55 billion = €0.90 = $1) to make up 37% of company revenues. The acquisition of Sigma-Aldrich (see ***IBO*** 9/30/14) boosted revenue growth by 77.4%, while currency impact was negligible. Sales were driven by continued strength for bioproduction solutions and demand in Asia. All sales figures below are organic.

Process Solutions sales expanded 10.1%, led by demand for filtration and single-use products. Applied Solutions sales improved 3.3%, as higher sales of biomonitoring products and demand for analytical testing offset lower instrument revenue. Sales for the Research Solution business slipped 0.4% due to weakness in Europe and a strong year-over-year comparison spurred by several large one-time orders.

Geographically, Asia-Pacific sales were highlighted, climbing 9.9% due to strong demand for purification products. Despite mixed business results, European sales advanced 5.5%. Within Europe, Process Solutions sales grew 12.9% but were partially offset by revenue declines in the Applied and Research Solutions businesses. Research Solutions sales were also lower in North America, yet sales for this region expanded 2.8%. Sales in Latin America grew 6.5%, led by strength in biomonitoring and analytical products within the Applied business. Sales in the Middle East and Africa region were roughly flat.



Incited by the acquisition, LS adjusted operating margin jumped 381 basis points to 26.4%. The company maintained its 2016 LS organic sales growth outlook of mid- to high single digits.

Merck KGaA Life Science Q3 FY16						
	Rev. (€M)	% of Rev.	% Rev. Growth	Currency	Acq./ Div.	Org.Growth
Process Solutions	540	39%	50.8%	0.1%	41%	10.1%
Research Solutions	495	36%	211.6%	-0.3%	212%	-0.4%
Applied Solutions	355	26%	46.6%	0.0%	43%	3.3%

Oxford Falls Despite New Products

For the fiscal half year ending September 30, Oxford Instruments sales grew 4.1% to £171.5 million ($225.7 million = £0.76 = $1). However, growth was driven by favorable currency translations following a sharp devaluation of the British pound. As such, currency-neutral sales fell 6.9% due to the completion of a large superconducting wire contract, which reduced sales growth by roughly 4%. Other headwinds included lower US and European academic funding, and continued challenges in industrial markets.

Despite strong growth in China and healthy contributions from new products, organic sales growth for the Nanotechnology Tools division declined 4.9%. Roughly half of this decline was attributed to the transition of Omicron into a joint venture (see ***IBO*** 5/31/15). In addition, demand within the Asylum Research business was negatively impacted by weak academic and industrial markets across North America and Europe. Conversely, NanoAnalysis sales were strong, driven by new materials characterization solution offerings for industrial manufacturing applications. Sales in the Andor Technology and NanoScience businesses improved due to greater adoption of Andor's new 3-D microscopy platform and increased funding for quantum technologies, respectively. Finally, sales in the Plasma Technology and joint venture ScientaOmicron businesses continued to progress.

Industrial Products revenue slumped 14.3% due to lower MRI contracts within the Superconducting Wire business, as well as softness in the metals and construction markets. Nevertheless, sales for the company's Pulsar benchtop NMR system advanced due to broader adoption in industrial markets as well as higher demand from academic customers. In addition, sales in the X-ray Technology business improved, driven by demand from medical and electronic OEM customers.

Sales in the Service division slipped 0.9%, as higher service sales from the company's own products, which grew 8%, were offset by lower demand for OEM refurbished imaging systems sold under the HealthCare brand.

Overall, orders grew 5.1% organically, including 15% growth in the Service division. Meanwhile, organic bookings expanded 7% for Nanotechnology Tools, but declined 10% for Industrial Products.

Given the declines in the Superconducting Wire business and weak academic funding, total currency-neutral sales in Europe and North America contracted 4.2% and 14.7%, respectively. Excluding the superconducting wire decline, currency-neutral European sales were flat. Sales in Asia improved 0.7%, as strength in China was muted by weakness in South Korea and other Asian regions.

Oxford Instruments adjusted operating margin declined 106 basis points to 11.1%, as strong currency benefits were offset by lower sales of refurbished imaging systems. The company projected flat fiscal 2017 sales growth as a result of the slower academic funding environment in the US and Europe, as well as declining sales in the health care business.

Oxford Instruments H1 FYE 2017					
	Rev. (£M)	% Total Rev.	Rev. Growth	Currency	Org. Growth
Nanotechnology Tools	£90.9	53%	6.4%	11%	-3%
Industrial Products	£42.9	25%	-5.7%	9%	-14%
Service	£37.7	22%	11.2%	12%	-1%

Pacific Biosciences' Orders Slow Again

Third quarter sales for Pacific Biosciences jumped 80.5% to $25.1 million. Excluding Contractual revenue, which was level with the previous year at $3.6 million, sales soared 108.5% to $21.5 million. Instrument revenue climbed 424% to $11.5 million, as the company ramped up shipments of its Sequel system. With more than 30 Sequel systems placed during the quarter, the total installed base reached over 75 units. Consumables sales advanced 21%, primarily due to usage of the RS II system. Although supply issues were resolved, demand for Sequel SMRT Cells were below company expectations.

Instrument orders were also disappointing and slowed for the second consecutive quarter. Total instrument bookings amounted to 20 units, resulting in a backlog of more than 40 systems. As communicated in the first half of the year, the company asserted that order delays were affected by the shortage of SMRT Cells. Furthermore, potential customers may be waiting for data generation from early adaptors of the Sequel system.

Gross margin expanded 324 basis points to 50.3%. Operating loss was $16.7 million compared to a profit of $2.6 million due to increased investments. Given the slower order growth, the company lowered its 2016 revenue growth forecast from 70% to a range of 55%–65% growth to $86–$90 million excluding Contractual revenue.

Pacific Biosciences Q3 FY16			
	Rev. ($M)	% Rev. Growth	% of Rev.
Product	$18.1	138.4%	72%
Service and Other	$3.5	26.2%	14%
Contractual	$3.6	0.0%	14%

VWR Growth Slows

VWR's third quarter sales grew 3.7%, 1.6% organically, to $1.14 billion. Currency reduced sales growth by 0.7%, while acquisitions contributed 2.8% growth. Sales were slightly below company projections because of weaker demand for equipment and instrumentation late in the quarter. Growth was further impeded by timing of orders and a stronger year-over-year comparison compared to the first half of the year. Overall, equipment and instrumentation sales declined in the low single digits organically. However, organic sales of chemicals and consumables grew in the mid-single digits and low single digits, respectively.

By end-market, VWR biopharmaceutical sales advanced roughly 3% organically. Bolstered by investment initiatives, government revenue grew approximately 6% organically. Industrial and health care organic sales advanced 2% each, while education sales declined 3%.

Organic sales for VWR's Americas segment improved 1.7%, led by double-digit growth from government customers. Biopharmaceutical and health care sales advanced approximately 3% and 2% organically, respectively. Industrial sales were roughly flat, and sales to education markets fell 2%. Including acquisitions, consumables, and equipment and instrumentation sales each grew in the low single digits, while chemicals sales climbed double digits.

VWR's EMEA-APAC sales growth advanced 1.4% organically, hampered by soft education and government sales, as well as lower-than-expected demand for equipment and instrumentation from biopharmaceutical customers. Conversely, industrial sales grew roughly 5%, including strength in the petrochemical, environment, microelectronics and natural resources markets. Furthermore, health care sales expanded 2%. By product, segment sales of consumables improved roughly 4%, equipment and instrument sales slipped 2%, and sales of chemicals were flat.

VWR gross profit margin expanded 30 basis points to 27.6% due to customer mix and improved pricing. Adjusted operating margin slipped 12 basis points to 9.6%. The company confirmed that its full-year sales are projected to reach the low end of its previous guidance of $4.54–$4.63 billion. Fourth quarter revenue growth is expected to mirror the third quarter performance.

VWR Q3 2016

	Rev. ($M)	% Total Rev.	% Rev. Growth	Currency	Acq.	% Org. Growth
Americas	$707.7	62%	6.0%	0.0%	4.2%	1.7%
EMEA-APAC	$428.4	38%	0.2%	-1.9%	0.7%	1.4%

Scanning Electrochemical Microscopy

Scanning probe microscopy (SPM) remains one of the most vibrant areas of technical development for microscopic imaging. In SPM, a nanopositioning system brings a physical probe with an ultrafine tip very close to the sample surface under study. Depending on the nature of the tip and the particular measurement mode being used, interactions between the surface and the tip lead to measurable changes in the system, which can be detected and recorded.

A plethora of such measurement modes exist, bearing on the physical, electrical, magnetic and other properties of the surface. As the positioning system moves across the sample, the instrument can assemble an "image" of the sample out of the measurements made at each location, or a particular location can be studied over time as conditions are varied. One specific measurement mode is scanning electrochemical microscopy (SECM), in which the probe is an ultramicroelectrode formed from a fine wire embedded in a glass probe, with just the tip of the wire exposed for detection. These electrodes can be less than a micron in diameter at the tip.

Typically, SECM measurements are carried out in an aqueous electrolytic medium to allow current flow, with the probe submerged and brought to the sample surface. When the probe is close enough, the readings from the electrode become very specific to the local area beneath the probe. In addition to providing readings of current, electrical potential and other electrochemical variables, the electrode can also be used to direct current to a particular location on the sample, manipulating the local conditions for an experiment. This active use of the electrode can also be used to create or modify nanostructures on the sample through deposition, etching or other processes.

The largest market for SECM is academia, and there are applications in a variety of disciplines from the chemistry of surfaces to the characterization of cell membranes. Research into catalysts, corrosion and deposition is found both in academia and also in industrial labs focusing on advanced materials and metals. Fuel cell design is another important area of study for SECM in the energy industry. Electronics materials and other nanotechnological devices can also be studied and manipulated with SECM. In the life sciences, in addition to studying cell membranes, the technique can be used for measuring enzymatic activity, biostructures and biosensors.

Since SECM remains a rarer specific technique, not all of the relevant SPM vendors provide SECM options. Bruker, the dominant market leader, has long supported the technique, and in September, the company introduced a PeakForce SECM mode for its Dimension Icon AFM, which provides high resolution simultaneous imaging of both topography and electrochemical properties. Princeton Applied Research (AMETEK) has wide expertise in electrochemistry, including systems for SECM. In September, AMETEK partnered with the Laboratory of Physical and Analytical Electrochemistry—École Polytechnique Fédérale de Lausanne to market the Swiss research institute's soft probe technology (see ***IBO*** 10/31/16), which overcomes difficulties that topographic effects can cause

in SECM. When Agilent Technologies spun off some of its businesses into Keysight Technologies, its SPM business was included in that, making the new company the third largest vendor of SECM.

Other major SPM vendors that offer SECM probes include Park Systems, JPK, Asylum Research (Oxford Instruments) and Nanonics. There are also a few smaller vendors that are highly focused on the SECM technique; these include Sensolytics, Heka (acquired by Harvard Bioscience in 2015, see ***IBO*** 1/31/15), CH Instruments and BioLogic Science Instruments.

SECM at a glance:

Leading SECM Suppliers:

- Bruker
- AMETEK
- Keysight

Largest Markets:

- Academia
- Metals
- Energy

SECM System Cost: $50,000–$200,000

Cancer

As of 2014, cancer research represented 4% of all global research, according to Elsevier's Scopus database. According to Elsevier's "Cancer Research: Current Trends and Future Directions" report, cancer research is defined as "research where the published results include 'cancer' or 'oncology' within the title, abstract, or list of keywords of publications [and] includes all publication types, namely articles, reviews, conference papers, book chapters, notes, letters, short surveys, editorials, articles in press, erratum, book conference reviews, business articles and abstract reports." Of the 4% figure, articles on cancer comprised 77% and reviews represented 14% of publications. Cancer research publications were found to be more commonly cited in patents than general medicine publications.

The US had the greatest output for cancer research, releasing 34,674 publications in 2014, a 6.6% increase. China followed with a 25% increase to 20,505 publications, while Japan's output increased 6.2% to 8,001 publications.

Although the US is the leader in publishing cancer research, due to the rapidly increased output of cancer research publications from countries such as China, the US's share in global cancer research and medical research has declined to a CAGR of 6% and 9%, respectively. China's CAGR for cancer research and medical research in 2014 was 23% and 19%, respectively. Canada's cancer research and medical research had a CAGR of 9% and 11%, respectively, while Italy's cancer research and medical research CAGR was 8% and 9%, respectively.

Trends in cancer research since 2011 include a greater focus on early cancer detection, neoplastic stem cells, microRNAs and biomarkers. The US in particular has concentrated on immunotherapy, xenograft models and studying tumor environments. Institutionally, Harvard leads in cancer research publications in terms of greatest output volume, with 13,0209 publications in 2014, while the Dana-Farber Institute holds the highest field-weighted citation impact.

Source: *Elsevier*

Pharmaceuticals

Based on a new report entitled “Outlook for Global Medicines Through 2021,” global expenditures on medicines will reach approximately $1.5 trillion by 2021, a $370 billion increase from estimated 2016 expenditure levels. The growth rate for medicine spending is estimated to decrease from 9% in both 2014 and 2015 to between 4% and 7% over the five-year period. The US and China are assumed to make up the two top markets for pharmaceuticals.

Half of all pharmaceutical expenditures will be for specialty medicines in the US, the UK, Germany, France, Italy and Spain, with these medicines also contributing to the acceleration of their share of global pharmaceutical spending, which is expected to grow from 30% in 2016 to 25% by 2021. The use of specialty medicines will also increase medicine costs, as they are 15–20 times more expensive than traditional brands.

Brand prices are also forecast to increase between 8% and 11%. Due to lower spending on brands because of an influx of patent expirations, the US pharmaceutical industry is expected to reduce R&D spending by an estimated $143.5 billion within the next five years. Of this figure, the reduction of spending on biosimilars will be between $27–$58 billion, representing between 25% and 35% of the impact of the total five-year spending reduction.

Cancer research, including immunology and cell therapy, is the top R&D category, and new platforms such as CRISPR are expected to shake up the personalized medicine market. By 2021, a record 2,240 drugs currently in late-stage development are expected to be released to the market, with an average 45 of active new substances predicted to launch each year.

Source: *QuintilesIMS Institute*

Energy

For the first time in eight years, the Organization of the Petroleum Exporting Countries (OPEC) has agreed to production cuts for global oil inventories. OPEC will reduce oil output production by 1.2 million barrels/day, exempting Nigeria and Libya. Iraq, however, has received its first oil production quotas since the 1990s. Iran, one of the three largest oil producers in the world, is permitted to increase its output to about 3.8 million barrels/day, while Saudi Arabia will reduce output to 10.06 million barrels/day, a 486,000 barrel decrease. Iraq has also agreed to cut oil production by 210,000 barrels/day, and the UAE and Kuwait will also decrease output by 139,000 barrels/day and 131,000 barrels/day, respectively. In 2016, OPEC received $341 billion from oil exports, down 54.7% from $753 billion in 2014. OPEC will meet again next year in May in order to decide whether to extend production cuts for another six months.

Source: *Bloomberg*

UK

Last month, the UK government released its “Autumn Statement,” which discussed the future of the British economy and federal funding allocations. According to the Statement, the UK is estimated to be the fastest growing region in the G7 in 2016, with a 2.3% growth in economic activity in Q3 FY16 and a 60.4% decrease in national deficit. The UK is assumed to undergo a period of unpredictability as it regroups from the impact of Brexit, due to which the Office of Budget Responsibility (OBR) forecasts that growth of GDP will slow to 1.4% in 2017 and reach a rate of 1.7% in 2018, 2.1% in 2019 and 2020, and 2.0% in 2021. The decrease is estimated to be largely due to less business investment and household spending.

The Statement refers to a new National Investment Policy Fund (NIPF), a fund put in place by the government to focus on housing, transport, digital communications and R&D. As part of the NIPF, between 2017–2018 and 2021–2022, the government will allocate £23 billion ($29.2 billion = £0.79 = $1), with total spending of £170 billion ($215.6 billion) over the next five years, or 1.7% of GDP by 2022. The expenditure includes £4.7 billion ($6.0 billion),

or an extra £2 billion ($2.5 billion) per year, for R&D to improve the UK's position in global science and innovation. This is a 20% increase to total federal R&D expenditure, marking the largest increase passed by UK Parliament since 1979. The government will also reevaluate the current R&D tax credits to make UK R&D more competitive.

Enhancing UK R&D is a vital aspect of the government's Industrial Strategy, and through the NIPF, the government will allocate funds for an Industrial Strategy Challenge Fund to encourage and foster scientific collaboration in the UK, as well as for improving the UK's research and business innovation through grants. An additional £100 million ($126.8 million) will be allocated to improve R&D programs such as the Biomedical Catalyst, as well as R&D facilities, technology transfer and research-to-business channels.

Source: *HM Treasury*

EU

A report outlining the last two years of progress of Horizon 2020, the EU's largest research and innovation framework program, indicated that the program is drawing a large number of researchers. From the program's establishment in 2013 to 2015, 76,427 eligible research proposals were received, and there was a 25.5% increase in the number of proposals submitted in 2015 compared to the previous year. In 2015, the number of high quality proposals received grew by 40.2%. High quality proposals that were funded in 2014 and 2015 made up 26% of total proposals, while the success rate for proposals (i.e., proposals which were retained for funding) was 12%.

Proposals with the lowest success rates in 2015 were in the Future and Emerging Technologies program, of which approximately 2% were retained for funding, a 72.7% decrease in success rate from 2014. In regards to funding, Future and Emerging Technologies' success rate was 8% in 2014 but dropped to 1.7% in 2015. In 2015, the proposal success rate for research infrastructures increased 3.8% to approximately 25%, while the funding success rate fell 13.4% to 25%.

The proposal success rate for the Small- and Medium-Enterprise program fell from 41% in 2014 to 25% in 2015, while the funding success rate tumbled 83.7%, from 63% to 10%. Private companies submitted 97,019 eligible applications in the first two years of the program. During the same time period, approximately €10.6 billion ($11.4 billion = €0.94 = $1) was allocated to university and research grants.

Source: *European Commission*

Nordic countries

In 2015, Nordic countries spent approximately NOK 335 billion ($39.95 billion = NOK 8.46 = $1) on R&D, a 3% increase. Iceland's R&D expenditure grew by 20%, followed by Norway and Sweden, with growth of 12% and 10%, respectively. However, Finland's R&D expenditure declined by approximately 7%, making the total nominal growth for R&D in the Nordic region 3% from 2014 and 2015. The business sector represented the majority of R&D expenditure growth in Iceland, Sweden and Norway, while Denmark had the highest R&D expenditure from the government and higher education sector. Finland R&D expenditure decreased in all sectors, especially government.

As a percentage of 2015 GDP, R&D in Denmark, Finland, Iceland, Norway and Sweden represented 3.0%, 2.9%, 2.2%, 1.9% and 3.3%, respectively. For Norway, this was a record high, while Finland's figure was the lowest since 1998. Per capita, Sweden had the greatest R&D expenditure, contributing NOK 14,000 ($1,670) in 2015, with Denmark following at approximately NOK 13,000 ($1,550), and then Finland at NOK 11,100 ($1,323) and Iceland at just below NOK 9,300 ($1,109).

Source: *Nordic Institute for Studies in Innovation, Research and Education*

Liquid Chromatography

Company Announcements

Zymoic announced in October that it is now selling **Skycam** HPLC and IC systems in the US.

Showa Denko named Kohei Morikawa as president and CEO, effective January 4, 2017. He is currently director, managing corporate officer and CTO. Current President and CEO Hideo Ichikawa will become a representative director and chairman.

In November, **Waters** announced a comarketing and reseller agreement with **SOTAX**, a provider of dissolution testing, automated sample preparation and physical testing of pharmaceutical dosage forms. Waters made available to SOTAX its ACQUITY HPLC H-Class System for sale to drug manufacturers performing small molecule, solid-dosage analysis in QC and analytical R&D. Waters licensed SOTAX as an independent distributor in the US, Canada, UK, France, Germany, Italy, Switzerland and the Czech Republic.

Novasep announced in November an extension of its partnership with **AR Brown** to include the commercialization of its chromatography systems for the Japanese pharmaceutical industry. AR Brown provides business development and technical services. **Allied Labs** will continue to provide equipment maintenance services for the systems in Japan.

In November, **Natrix Separations** announced a development agreement with **Merck** and **Sanofi** to advance its new membrane-based Protein A platform for antibody purification. Natrix also announced an agreement with **Scil Proteins** for the engineering and development of the Protein A ligand that will be integrated with Natrix's membrane technology.

Product Introductions

In October, **Phenomenex** introduced the Luna Omega Polar C18 stationary phase in a high performance 1.6 µm particle for UHPLC and a low pressure 5 µm particle for direct scalability to analytical HPLC from preparative work. They deliver a wide elution window and combined high retention for polar and nonpolar analytes. The company also released the Luna Omega PS C18 with mixed-mode selectivity.

In November, as part of its Clarity BioSolutions portfolio, **Phenomenex** released two new particle chemistries for characterization and purification of synthetic oligonucleotides: the core-shell Clarity Oligo-XT for reversed-phase LC analysis and purification, and the nonporous Clarity Oligo-XAS, a strong anion exchanger for characterization.

Waters introduced in November two new chemistries for its CORTECS Columns product line. CORTECS T3 features an increased pore diameter (120 Å vs. 90 Å) along with lower C18 ligand density and proprietary end capping. The Shield RP18 columns utilize an embedded carbamate functional group into the alkyl ligand, which provides alternative selectivity for basic and polyphenolic compounds when compared to typically bonded C18 phases.

Shimadzu launched in November the Nexera UC/s (SFC/HPLC Switching System) for LC and SFC on a single system. LC units already installed can be upgraded to the Nexera UC/s at a cost of approximately half the price of a new SFC.

Biotage launched in December the Biotage SNAP Bio C18 and Biotage SNAP Bio C4 flash cartridges for peptide purification, featuring wide pore media (300 Å).

Life Science Consumables

Company Announcements

Illumina announced in October that the **Human Heredity and Health in Africa Initiative** selected it to develop an array for African genomic research.

Meridian Bioscience announced in October that its Life Science segment will exit biopharma enabling services, which represented $2–$3 million in annual revenue.

Fiscal 2016 sales for the year ending September 30 for **Meridian Bioscience Life Science** increased 4.6% to $51 million, or 26% of revenues. Within the segment, sales of Molecular Components were flat at $21 million, while sales of Immunoassay Components rose 8.0% to $30.4 million. Life Science Chinese sales totaled $4.1 million, with Immunoassay Components accounting for 76%.

ATCC announced in October a strategic partnership with contract testing services provider **BioAgilytix** to develop new and custom cell-based assays. ATCC also took a minority stake in BioAgilytix.

Emulate announced in October a strategic collaboration with the **Lawrence J. Ellison Institute for Transformative Medicine of USC** to use its Organs-on-Chips technology for translational cancer R&D. The company also announced a strategic collaboration with **LabCorp**, which seeks to establish Organs-on-Chips as a new preclinical testing platform. The first application is focused on the Kidney-Chip.

In October, **Emulate** expanded its Series B financing with an additional $17 million in equity funding, bringing the total amount raised in the Series B round to $45 million.

Edinburgh Research & Innovation, the commercialization arm of the **University of Edinburgh**, announced in October a license agreement with the life science business of **Merck KGaA** for technology to fluorescently label peptides with minimal interference with peptide structure.

In October, **Santa Cruz Biotechnology** opened a sales office near Toronto, Canada.

Mercia Technologies announced in October a £1 million ($1.2 million) follow-on investment in synthetic biology company **Oxford Genetics**. Mercia holds a 47% stake in the company, having invested £2.2 million ($2.7 million).

In October, **New England Biolabs** (NEB) signed a reagent supply agreement with **AmpTec**, a manufacturer of synthetic long RNAs and functional mRNAs. NEB will manufacture and supply enzymes for in vitro transcription and capping of RNA.

In November, **ERS Genomics** licensed its CRISPR-Cas9 genome editing intellectual property for use in engineering model organisms to **Knudra Transgenics**. Knudra will use the license to engineer C. elegans and D. rerio (zebrafish) to build custom models and develop related products.

In November**, Betin Pharma** announced that it will distribute **INDIGO Biosciences'** nuclear receptor assay kits in Europe.

OriGene Technologies announced in November a multiyear strategic agreement with China-based **EdiGene** to develop genome-wide knockout cells for commonly used lab cell lines (see below).

In November, **MilliporeSigma** entered into a set of agreements with drug discovery and development partnership company **Evotec**. Evotec will provide screening services for MilliporeSigma's collection of genetic reagents, such as CRISPR and shRNA libraries.

In December, **Desktop Genetics** and **LGC** announced the awarding of funding from the UK's **SynbiCITE** project to develop screening and validation tools for functional genomics, cell line engineering and synthetic biology.

Genome engineering technology company **Muse bio** named Dr. Kevin Ness as CEO and a Board member in December. Founding CEO Ryan Gill will become CSO. Dr. Ness was previously cofounder, CTO and COO of **10X Genomics**.

In December, **Agilent Technologies** announced a partnership with **Transcriptic** to develop novel synthetic biology solutions. Transcriptic will add multiple Agilent Genomic product lines for mutagenesis and cloning to the protocol library within the Transcriptic robotic cloud library. The first product, QuikChange Lightening, will accelerate the generation of multiple mutants for large protein function projects.

DNA2.0 announced in December that it has changed its name to **ATUM**.

Product Introductions

In November, **Irvine Scientific** introduced PRIME-XV Mouse Hematopoietic Cell Basal Medium, a serum-free basal medium supporting self-renewal of mouse hematopoietic progenitors while maintaining their differentiation potency.

Under an agreement with **EdiGene** (see above), in November, **OriGene Technologies** introduced the Knockout Cell Lysates, which can be used to validate antibodies for specificity or used as negative controls for Western blot analysis. They are sold in a kit format.

MilliporeSigma introduced in December the MILLIPLEX MAP Human High Sensitivity cytokine panel for faster, more economical assays, calling it "the first 384-well kit for use with the Luminex FLEXMAP 3D platform."

In December, **Miltenyi Biotec** launched its REAfinity portfolio of recombinant antibodies, optimized for flow cytometry and designed to improve research reproducibility.

Laboratory Products

Company Announcements

In October, **Avantor Performance Materials**, a provider of laboratory chemicals, and **NuSil Technology**, both majority owned by **New Mountain Capital**, completed a merger agreement. The combined company is named Avantor and has annual revenues of more than $700 million, with 14% organic growth.

In November, **Honeywell** announced the launch of Honewell Research Chemicals, which includes several brands, as well as solvent and inorganic chemical products acquired from **Sigma-Aldrich** last year (see ***IBO*** 10/31/15). The business consists of four product portfolios: Honeywell Fluka, **Honeywell Riedel-de Haën, Honeywell Burdick & Jackson, and Honeywell-branded products. A purchasing website has also been launched.**

In November, Honeywell named Scientific Laboratory Suppliers a National Distribution Partner for the UK for its Honeywell Research Chemicals business.

Quartzy.com, an online lab management platform, announced in October the addition of **Rainin**, a **Mettler-Toledo** business, as a supplier.

In November, **Mitsui & Co**. announced that it will purchase a 22% stake in **Panasonic Healthcare**, a provider of medical devices, health care products and laboratory equipment, from **KKR** for $510 million. The investment will add to Mitsui's diabetes and medical device businesses.

Product Introductions

In September, **INTEGRA** launched a new plate holder enabling 1536-well pipetting on its VIAFLO 384 electronic handheld pipette. The plate holder is adjustable in the y-direction. The company also announced a new 12.5 µL SHORT GripTip pipette tip.

Mettler-Toledo introduced in September the SevenCompact Duo dual-channel benchtop meter, which combines pH/mV and conductivity measurements.

YSI, a **Xylem** brand, introduced in September the affordable Pro20i handheld DO meter for wastewater facilities.

In September, **AirClean Systems** released the Endeavour Ductless Fume Hoods, featuring a multi-language and multi-unit capability.

Distek introduced in September the Opt-Diss 410 next generation in situ UV fiber optic system for dissolution testing, which measures directly from the vessel. Two components can be quantified at once without the need for separation. A single software system controls the entire platform.

In September, **Mettler-Toledo** released the Thermotrode sensor, which is designed for challenging industrial environments, and an ASTM D8045 thermometric acid number standard for its Titration Excellence line platform.

In October, **Panasonic** launched the MDF-DU900V VIP -86°C Upright Freezer for long-term preservation of laboratory samples. It has a volume of 845 L. Up to 672 2-in. boxes can be stored within 1 m^2.

In October, **Xcell Biosciences** named **Cambridge Bioscience** as its exclusive UK distributor and **BioStream** as a Japanese distributor.

Syrris introduced in October the floor standing Orb Pilot jacketed reactor for pilot-scale batch chemistry. It offers a choice of vessel sizes from 10 L to 50 L.

In October, for its dissolution testing systems, **Pion** released FLUX technology for real-time, in vitro–in vivo correlation absorption testing for predicting the absorption potential of finished dosage products prior to clinical trials. It consists of a stirred dissolution chamber, stirred receiver vessel and the Pion Pampa GIT artificial membrane, which mimics the behavior of the gastrointestinal wall.

Thermo Fisher Scientific launched in October the Thermo Scientific TSX Series refrigerators and freezers for lab and clinical settings, including refrigerators for blood banks and pharmacies, and lab freezers.

In October, **Artel** released its new PCS software, a fully integrated software solution that allows testing of all elements important to pipetting. Built-in operator assessment tools allow lab managers to standardize pipetting techniques across an entire organization.

In November, exclusive to the US, **Qorpak** released a new 250 cc straight-sided, wide-mouth borosilicate glass jar, manufactured from Type 1 borosilicate glass.

Restek released in November the new Resprep VM-96 vacuum manifold, which is compatible with 96-well plates from any manufacturer.

In November, **Panasonic Healthcare of North America** introduced the large capacity VIP Series MDF-DU900VC-PA -86°C freezer. Capacity is 672 2-in. boxes or 448 3-in. boxes in a 10.79 ft^2 footprint. The VIP Series now includes six product sizes.

Hanson Research launched in November the Phase One disintegration tester, a two-beaker system, featuring easy assembly, installation and operator training.

Earlier this year, Indian lab glassware maker **Borosil Glass Works** launched the Labquest brand of laboratory products and equipment.

Sales/Orders of Note

In September, **Kewaunee Scientific** announced an $18.5 million contract, through its dealer **ATC**, for the new College of Science complex at **Kuwait University's Sabah Al-Salem University City**.

Surface Science

Company Announcements

In November, **Leica Microsystems** entered into an exclusive licensing agreement with **Columbia University** to commercialize SCAPE (Swept Confocally Aligned Planar Excitation) microscopy for life science applications. SCAPE

microscopy forms 3-D images of living samples by scanning them with a sheet of laser light. SCAPE delivers 3-D imaging speeds up to 10–100 times faster than conventional point scanning microscopes while maintaining the benefits of light sheet imaging. The company also exclusively licensed OPM (Oblique Plane Microscopy) technology form **Imperial Innovations**.

ClearLight Diagnostics exclusively licensed in November from **Stanford University** IP rights covering inventions related to SPED (Spherical-aberration-assisted Extended Depth-of-field) light sheet microscopy and new RNA interrogation technology for multiplexed, volumetric visualization of both long and short RNAs in a variety of intact tissues.

Thorlabs announced in November a licensing agreement with **Howard Hughes Medical Institute** to commercialize 2p-RAM (two-photon Random Access Mesoscope) for in vivo imaging of large brain volumes (up to 5 mm x 1 mm) with single neuron resolution. Sales are expected to start in the first quarter of 2017.

In November, **NT-MDT**, a Russian provider of AFM systems, announced a reorganization to become **NT-MDT Spectrum Instruments** so as to expand its range of AFM modes. Spectrum Instruments was the exclusive distributor of NT-MDT products.

In November, **WITec** opened an office in Beijing, China.

ZEISS announced in November the establishment of ZEISS Digital Partners in Munich, Germany, a new competence center to leverage the opportunities offered by digitalization for its customers, partners and employees. The center will grow to 100 employees over the next two years.

ZEISS announced in November €1 million ($1.1 million) in support for innovative research projects at the **Swiss Federal Institute of Technology** as part of its partnership with the organization.

In December, **Florida Atlantic University's Brain Institute** announced the opening of a **Nikon** Center of Excellence, one of seven such Centers in the US and 17 worldwide. It is the first Nikon Center of Excellence in the Southeast US.

Product Introductions

In November, **Leica Microsystems** introduced HyVolution 2 Super-Resolution Technology, which allows a resolution down to 140 nm, for all Leica TCS SP8 systems. Also released was the Leica TCS SP8 STED ONE Nanoscope for 2-D and 3-D imaging, which achieves resolution down to 30 nm and allows the co-localization of molecules to be reliably quantified.

ZEISS launched in November the ZEISS Celldiscovery 7 for live-cell imaging. It combines the user friendly automation features of a boxed microscope with the image quality and flexibility of a classic inverted research microscope. It features hardware-based autofocus and a new optical design.

In November, **Bruker**'s Nano Surfaces Division released a nanoscale scratch option for its NanoForce Nanomechanical Testing System, expanding the platform's capabilities to characterize the resistance of thin films and coatings.

Oxford Instruments launched in November a new electrochemistry cell for its Cypher ES AFM for studying electrochemical reactions in situ.

Tescan introduced in November the Xe plasma FIB column technology, capable of achieving resolution of < 15 nm at 30 keV, extending its range of use into the area of traditional gallium FIB applications.

Reported Financial Results

$US	Period	Ended	Sales	Chg.	Op. Prof.	Chg.	Net Prof.	Chg.
HTG Molecular Diagnostics	Q3	30-Sep	$0.9	-9.6%	($6.1)	-25.6%	($6.5)	-25.8%
MOCON	Q3	30-Sep	$16.1	6.9%	$2.6	58.9%	$2.0	70.5%
Neogen	Q1	31-Aug	$83.6	11.7%	$14.7	-1.0%	$9.9	6.0%
Pressure Biosciences	Q3	30-Sep	$0.5	-7.8%	($0.5)	34.6%	($0.9)	-44.0%
Repligen	Q3	30-Sep	$24.7	24.5%	$3.7	1.6%	$1.2	-54.5%
Roka Bioscience	Q3	30-Sep	$1.9	25.0%	($7.2)	11.0%	($9.5)	-11.5%
Other Currencies								
Borosil Glass Works (Scientificware)	FYE	31-Mar	INR 1,191.0	17.2%	INR 293.1	14.3%	NA	NA
Borosil Glass Works (Scientificware)	Q1	30-Jun	INR 432.5	53.9%	INR 121.1	98.5%	NA	NA
Borosil Glass Works (Scientificware)	Q2	30-Sep	INR 318.1	34.2%	INR 66.5	89.5%	NA	NA
Diploma (Life Sciences)	FYE	30-Sep	£109.9	6.6%	£16.7	-6.7%	NA	NA
DKK-TOA	Q2	30-Sep	¥3,407	-7.2%	¥272	-17.3%	¥207	-15.9%
Pfeiffer Vacuum Technology	Q3	30-Sep	€ 114.5	0.0%	€ 15.2	-0.7%	€ 10.5	-0.9%
Photon Control	Q3	30-Sep	CAD 8.7	46.4%	CAD 2.7	26.8%	CAD 2.2	11.0%
ReproCELL	Q2	30-Sep	¥250	-9.2%	-¥223	-7.0%	-¥241	16.9%
Takara Bio	Q2	30-Sep	¥6,893	-8.0%	¥734	28.1%	¥382	111.0%